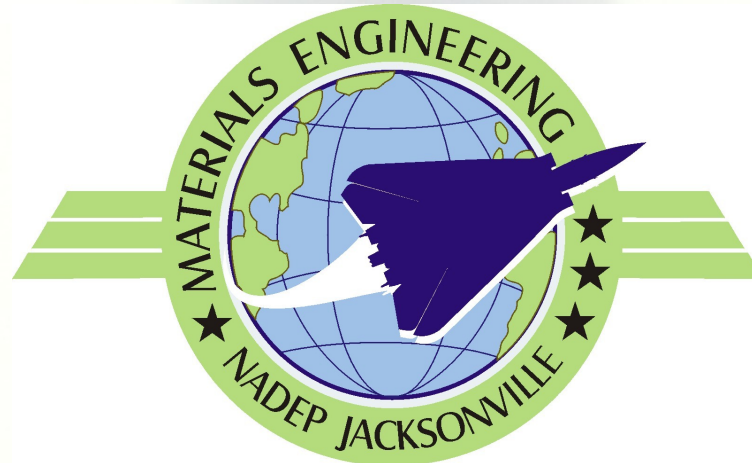
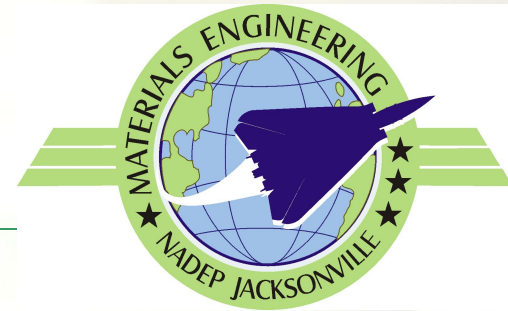


NADEP Jax Powder Coat Implementation Proposal



Powder Coat

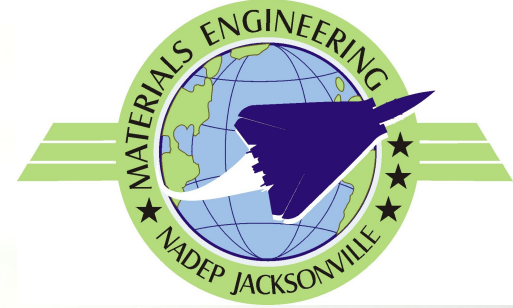
What is it



- Powder coating is a dry finishing process, using finely ground particles of pigment and resin which are electrostatically charged and sprayed onto a part to be coated.
- The parts to be coated are electrically grounded so that the charged powder particles projected at them adhere to the parts and are held there until melted and fused into a smooth coating in the curing oven.
- The Powder selected is Polyester TGIC coating with an epoxy functional crosslinker triglycidylisocyanurate (TGIC). TGIC's have very good adhesion characteristics, corrosion resistance and exterior durability.



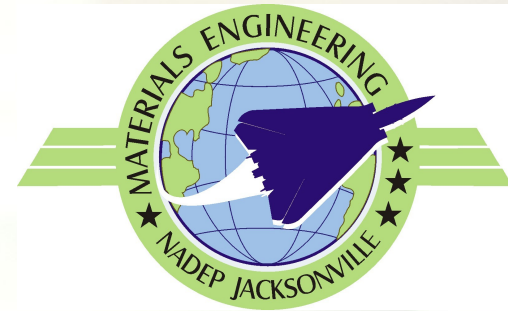
Powder Coat



Advantages

- **Cost-**
 - \$5.00 LB Versus \$50.00 Gal. (1 lb. of Powder is equivalent to 3 Gallons of Paint)
 - Clean Up (no extra solvent required for equipment maintenance)
- **Turn Around Time**
 - 20 Minutes for Powder to Cure versus 2 Hours for Solvent Paint System
 - Coating full performance attained in 20 minutes for powder vs. 14 days
- **Environmental**
 - NO Hazardous Air Pollutants Emitted
 - NO Volatile Organic Compounds Emitted
 - NO Special Permitting
 - NO Hazardous Sludge Created (Waste can be easily disposed/reused).
- **Finish Quality Advantages**
 - Consistent Results/Mechanical Properties/ Corrosion Resistance
 - No mixing required, or viscosity adjustments required: less room for error

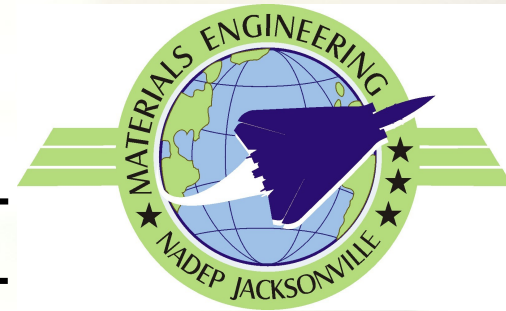
Powder Coat



Disadvantages

- Curing requirements
 - 390°F for 20 minutes
- Certain application limitations
 - Intricate shapes
 - Assembled components

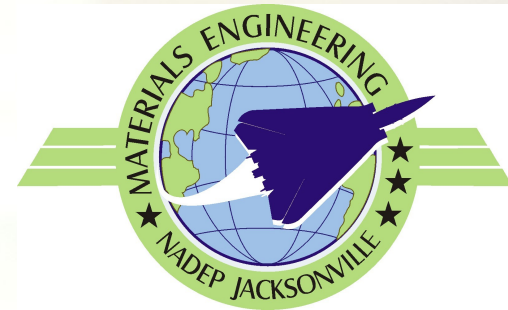
Powder Coat



Powder Coat Test M

- Corrosion (as a system)
 - Currently used system designed for aluminum (MIL-PRF-85582, type I; MIL-PRF-85285)
 - New baseline had to be established for steel
 - Requirement found in AMS-P-38336 Primer Coating, inorganic, Zinc Dust Pigmented, Self-Curing, for Steel Surfaces.
- Performance Requirement for the Coating
 - MIL-PRF-85285 used as baseline

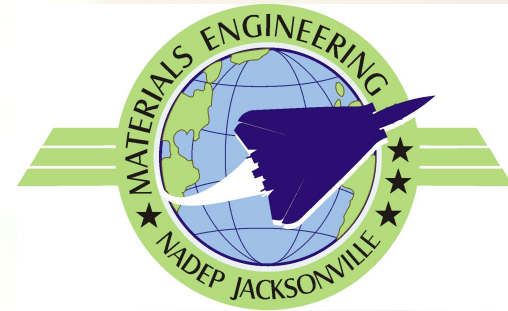
Powder Coat



Powder Coat Test Protocol

- Adhesion per section 3.7.7 of MIL-PRF-85285
 - Powder coat performed as good as polyurethane
- Water resistance per 4.5.7 of MIL-PRF-85582 (for topcoated samples)
 - Powder coat performed as good as polyurethane

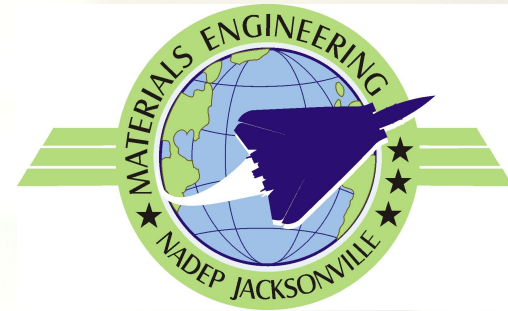
Powder Coat



Powder Coat Test Protocol

- Flexibility
 - Ambient temperature impact (per 3.7.8. MIL-PRF-85285)
 - Original set of powder coated panels failed.
 - Test was conducted again with new powder and new oven profiling
 - All panels passed
 - Low temperature ($-60^{\circ}\pm 5^{\circ}\text{F}$) bend over 1" mandrel (per 3.7.8.2 of MIL-PRF-85285)
 - Powder coated panels passed

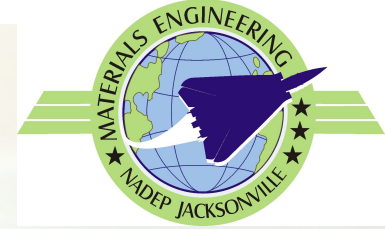
Powder Coat



Powder Coat Test Protocol

- Fluid Resistance per 3.8.1 of MIL-PRF-85285
 - Lubricating oil (MIL-L-23699) at $250^{\circ}\pm 5^{\circ}\text{F}$
 - Powder coat passed
 - Hydraulic fluid (MILH-83282) at $150^{\circ}\pm 5^{\circ}\text{F}$
 - Powder coat passed
- Recoatability
 - Applying MIL-PRF-85285 over powder coat
 - No adhesion incompatibility

Powder Coat



CORROSION - SALT FOG ASTM B117

IVD 1010 PANELS

- Powder coat (TGIC) performed as good as if not better than MIL-PRF-85285
- Water immersion affects salt fog resistance
 - For both coating systems

Panel ID	Surface	thickness	500 hours	Ave.500	1000 hours	Ave.1000
1-1	I-C-P-PC	4	6	8	5	5
1-2	I-C-P-PC	4.6	10		6	
1-3	I-C-P-PC	5.2	9		5	
1-4	I-C-P-TC	1.4	6	7	5	5
1-5	I-C-P-TC	1.6	9		5	
1-6	I-C-P-TC	1.6	7		4	
1-7*	I-C-P-TC	1.5	0	0	*	*
1-8*	I-C-P-TC	1.7	0		*	
1-9*	I-C-P-PC	4.7	1	2	1	2
1-10*	I-C-P-PC	3.9	2		2	

*PANELS WERE WATER RESISTANCE TESTED PRIOR TO SALT FOG TEST

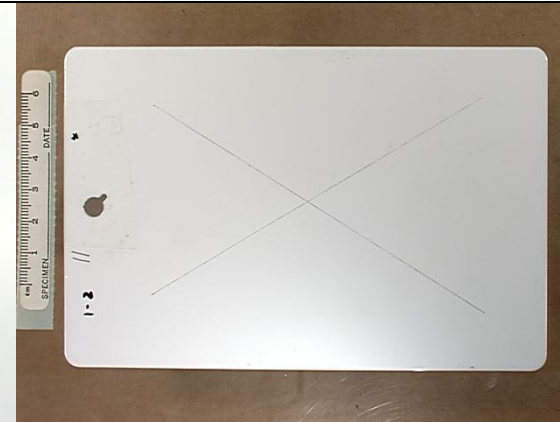
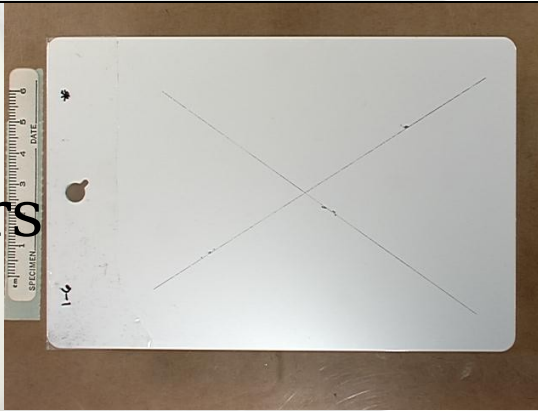
Panels were salt fog tested for 30 days, unscribed per requirements of AMS-P-38336 prior to scribing and re-testing

Powder Coat

Corrosion Test Results

1010 IVD Panels

500 Hours



1,000 Hours



MIL-PRF-85582,
MIL-PRF-85285

MIL-PRF-85582
Powder TGIC

Powder Coat



CORROSION - SALT FOG ASTM B117

IVD 4340 PANELS

- Powder coat (TGIC) performed as good as if not better than MIL-PRF-85285
- Conversion coating the IVD did not appear to make a significant difference.

Panel ID	Surface	thickness	500 hours	Ave.500	1000 hours	Ave.1000
4-1	I-C-P-PC	4.7	9	9	9	8
4-2	I-C-P-PC	5.7	10		9	
4-5	I-C-P-PC	3.7	7		5	
4-12	I-P-PC	4.9	9	9	5	5
4-13	I-P-PC	4.5	9		5	
4-6	I-P-PC	5.3	9		5	
4-7	I-P-TC	2.1	5	6	4	4
4-8	I-P-TC	1.8	6		3	
4-9	I-P-TC	2.1	6		4	

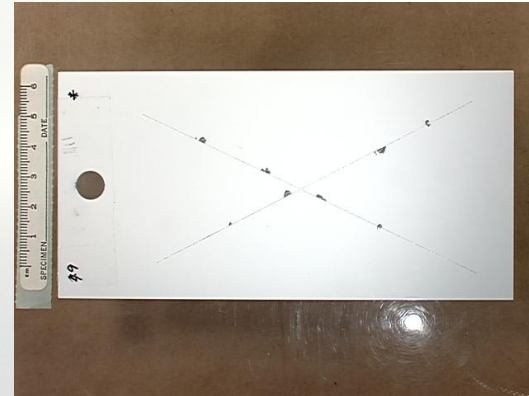
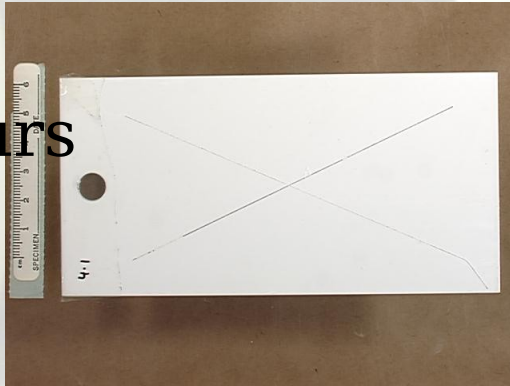
Panels were salt fog tested for 30 days, unscribed per requirements of AMS-P-38336 prior to scribing and retesting 1

Powder Coat

Corrosion Test Results

4340 IVD Panels

500 Hours



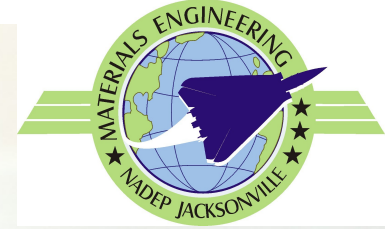
1,000 Hours



MIL-PRF-85582
Powder TGIC

MIL-PRF-85582,
MIL-PRF-85285

Powder Coat



CORROSION - SALT FOG ASTM B117

Bare 1010 PANELS

Different surface treatments and primers

- Solvent-based epoxy-polyamide primer (MIL-DTL-24441/20) did not outperform the waterborne (MIL-PRF-85582, type I)
- Most significant corrosion improvement found by phosphating prior to priming (MIL-P-16232)
- Powder coat as good as topcoat (MIL-PRF-85285)

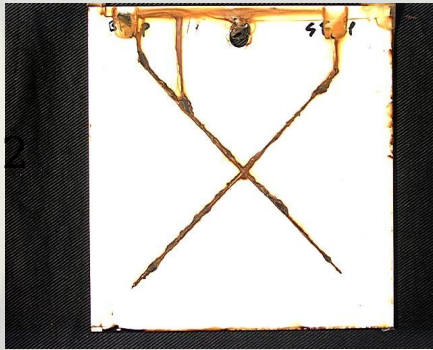
Surface	thickness	500 hours	Ave.500	1000 hours	Ave.1000	1500 hours	Ave.1500	
B-P-PC	2	6	6	0	2	*	0	
B-P-PC	3.1	6		3		0		
B-P-TC	3	6		0		*		
B-P-TC	2.8	7	7	6	2	0	0	
B-P-TC	2.6	7		0		*		
B-PE-PC	3.3	5		4		0		
B-PE-PC	3.1	6	6	0	2	*	0	
B-PE-PT	3.5	6		0		*		
B-PE-PT	3.8	6		0		*		
B-PH-P-PC	3.4	7	7	7	7	7	7	
B-PH-P-PC	3.2	7		7		7		
B-PH-P-PT	1.3	7		7		5		
B-PH-P-PT	1.3	7	7	6	7	6	6	

Powder Coat

Corrosion Test Results

1010 Panels

MIL-PRF-85582
Powder TGIC



500

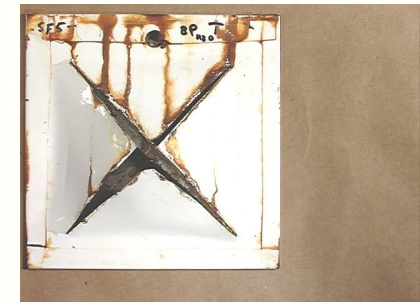


1,000



1,500

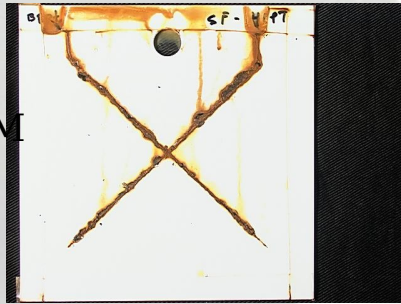
MIL-PRF-85582
MIL-PRF-8528



Powder Coat

Corrosion Test Results

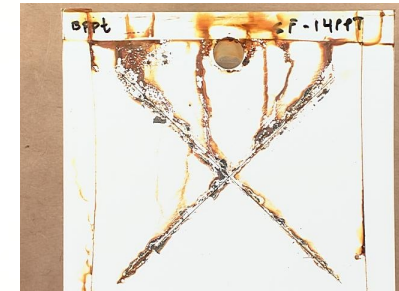
1010 Panels



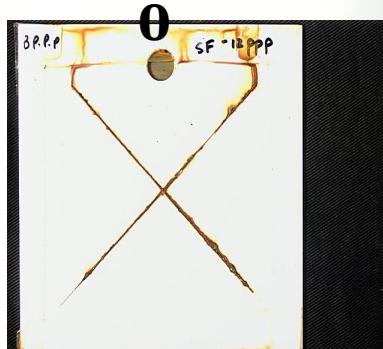
50



1,000



1,500



0

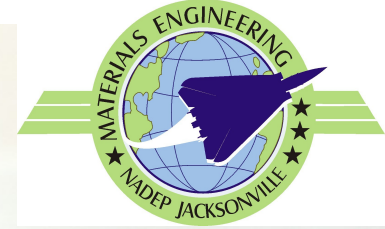


Powder Coat

15

MIL-P-16232, type M
MIL-PRF-85582,
MIL-PRF-85285

MIL-P-16232, type M
MIL-PRF-85582
Powder TGIC



Proposed Process Changes

- Current Process
 - Steel Parts that are IVD
 - Conversion coat
 - Prime (waterborne)
 - Topcoat (MIL-PRF-85285)
- Proposed Process
 - Steel Parts that are IVD
 - Conversion coat
 - Prime (waterborne)
 - Powder coat (TGIC)
 - Bare steel parts
 - Phosphate
 - Prime
 - Powder

Powder Coat



Sample Proposed Parts

- Oxygen bottles
- P3 MLG Piston
- P3 MLG Cylinder
- P3 MLG Trunion
- F14 Engine Mounts
- EA-6B Duct Assy. Air Inlet

Powder Coat



FUTURE POTENTIAL

- Change from epoxy primer to zinc-rich powder primer
- High temperature applications

Powder Coat